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FACTORS AFFECTING UNDER-FIVE MORTALITY

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ARTICLE INFO	ABSTRACT
	The aim of this paper is to identify the most important variables affecting the under-five mortality rate and to suggest some recommendations that could reduce it. The data used in this study is obtained from the Sudan Multiple Cluster Indicators Survey (MICS) conducted in the year 2014 in a joint work between the Central Bureau of Statistics and the United Nations Children's Emergency Fund (UNICEF).The multiple linear regression model was used to estimate the relationship between under-five mortality and the explanatory variables. Our study found that having a birth in a health facility, having assistance at delivery by a skilled attendant, giving Tetanus Toxoid vaccination during pregnancy, having antenatal care during the pregnancy and entering marital union for girls before their 15th birthday are significantly affecting under five mortality rates. Based on these results, the provision of well-configured health centers in all parts of Sudan with the provision of appropriate medical staff and vaccination needs for all childhood diseases as well as tetanus toxoid tends to be the most important variables in reducing under–five mortality rate in Sudan.

INTRODUCTION

The under–five mortality rate is defined as "the probability that a child born in a specific year or time period will die before reaching the age of five, if subject to current age specific mortality rates, Expressed as a rate per 1,000 live births". (UNICEF *et al.,* 2007). Although the under-five mortality rate in Sudan gradually decreased from 131 deaths per 1,000 live births in 1990 to 63.2 deaths per 1,000 live births in 2017, Sudan is still among the countries that have not made satisfactory progress in reducing the under-five mortality by two thirds (target 4.A of the 4th-millennium development goal).This paper aims to identify the most important variables affecting the under-five mortality rate and to suggest some recommendations that could reduce it.

THEORETICAL FRAMEWORK

According to Whitney *et al.,* (2016), delivering in a health facility was associated with a significantly increased odds of Infant Mortality (IM) in Ghana and Sierra Leone. Stanley *et al.,* (2016), found no statistically significant associations between the use of health professionals during childbirth and IM for women in Ghana, Kenya, and Sierra Leone. The prevalence of newborn death (3.12%) was significantly higher among women who did not receive any ANC check-up

compared with (1.67%) for those attending at least one check-up in low-income and middle-income countries (Kuhnt and Vollmer, 2017). The results of the study done by Almazrou *et al.,* (2007) shows a strong negative association between infant and child mortality and parental education in Saudi Arabia. The rate of mortality for infants with illiterate mothers is 22 per 1000 live births compared to 11 per 1000 live births for those of mothers with secondary education and above for the year 2004. Considering father's education, the results are to some extent the same, rates for the year 2004 were 21 and 11 per 1,000 live births for those with illiterate fathers and those who their fathers with at least secondary education respectively (Almazrou *et al.,* 2007). According to Finlay *et al.,* (2011), "*in low- to middle-income countries, Children born to women aged 12–14 or 15–17 are significantly more likely to die in their first year of life than children born to women aged 27–29*". Exposure to marriage at the legal age of 18 years compared to the possibility of marriage at the age of 15 years reduces the probability of infant death to the virgin child by 7.9 percentage points (Hombrados, 2017). Access to municipal water reduces the risk of child mortality (Ali *et al.,* 2003). The risk of post-neonatal and child mortality in Nigeria is significantly increased among households with unimproved water and sanitation (Ezeh *et al.,* 2014). Sanitation has a more pronounced effect on mortality than water (Ali *et al.,* 2003).Improved sanitation dramatically reduces infant and

under-five mortality at a 99% confidence interval (Alemu *et al.,* 2017). According to (WHO, 2017), Although TB affects men more than women, but pregnant women are susceptible to infection greater than non-pregnant. TB in mothers increases the risk that babies will die by six times, and doubles the risk of their being born prematurely or with low birth weight. HIV/AIDS infections further complicate these pregnancies. TB in pregnant women living with HIV increases the risk of maternal and infant mortality by almost 300 percent. In Africa where Sudan is in, TB rates are up to 10 times higher in pregnant women living with HIV than in pregnant women without HIV infection. Tetanus can affect people of all ages, but the disease is particularly common and serious in newborns and their mothers when mothers are unprotected from tetanus by vaccine tetanus toxoid. Neonatal tetanus, which is mostly fatal, is particularly common in difficult to reach and rural areas where deliveries take place at home without adequate sterile procedures and in unclean environment. Babies are affected because they have no immunity that passes from the mother who has not been immunized. Immunization of pregnant women or women of childbearing age with at least two doses of tetanus toxoid is estimated to reduce mortality from neonatal tetanus by 94% [95% confidence interval] (Blencowe *et al.,* l, 2010). It is therefore of high importance that pregnant women should take the Tetanus Toxoid vaccine.

THE STATISTICAL METHODOLOGY AND DATA

This study depends upon data collected by the government of Sudan with collaboration with the United Nations Children's Emergency Fund (UNICEF) in the year 2014 Within the Multiple Indicators Cluster Survey (MICS) program. In addition to the dependent variable (Under-Five Mortality Rate (U5MR)), the independent variables used in this study are as follows: Place of delivery (Pd) where measured by percent distribution of women age 15-49 years with a live birth in the last two years who delivered their last birth in a health facility, Antenatal care services (Ac) measured by percent distribution of women age 15-49 years with a live birth in the last two years who had her antenatal care during the pregnancy for the last birth by skilled provider, Type of birth attendant (Ba) measured by percent distribution of women age 15-49 years with a live birth in the last two years who had her assistance at delivery by a skilled attendant, Access to an Improved Water Source (Iw) measured by percent distribution of household population using improved drinking water sources, Access to an Improved Sanitation (Is) measured by percentage of household population using Improved sanitation, Mother's education (Me) measured by percentage of women age 15-24 years who are literate, Mother's age at the time of birth (Ma) Percentage of women age 20-24 years who have had a live birth before age 18, Adolescent marriage (Am) measured by percentage of women age 15-49 years who first married or entered a marital union before their 15th birthday, knowledge of risk signs (Rs) measured by percentage of mothers/caretakers who recognize at least one of the two danger signs of pneumonia (fast and/or difficult breathing), Rate of Immunization for Tuberculosis (It) measured by percentage of children age 24-35 months currently vaccinated against vaccine-preventable childhood diseases and Tetanus Toxoid vaccination during pregnancy (Tt) measured by percentage of women age 15-49 years with a live birth in the last 2 years protected against neonatal tetanus

The study applied backward method of regression to determine the most important factors that can affect Under-Five Mortality Rate.

RESULTS

Table (1) below reports the results of the best-fitted equation for the relationship between Under-Five Mortality Rate (U5MR) as the dependent variable and the independent variables mentioned above, the figures in parentheses are the t-ratios of the estimated parameters and those inside the square brackets are the significance levels of the parameters. Accordingly, the early stages as shown in equation 1 and 2 none of the variables shows a significant impact on under-five mortality, in later stages, and by excluding one independent variable at a time, additional independent variables appear to have a significant impact on under-five mortality until we reach the last equation, which is the best-fitted equation. In equation (7) we observe that from five statistically significant variables, three variables have the expected sign in explaining under-five mortality, namely; Place of delivery (Pd), Tetanus Toxoid vaccination during pregnancy(Tt), and Type of birth attendant (Ba), with coefficients estimated at (-3.32), (-2.55) and (-2.72) respectively. That means delivering in a health facility, having an assistant by a skilled person during delivery and vaccinating against neonatal tetanus will reduce the risk of infant and child mortality. While Adolescent marriage (Am) and Antenatal care services (Ac) are appeared with an unexpected signs. The value of adjusted R-Squire estimated at (0.63) Shows that the above mentioned variables are responsible of 63 percent of the change in under-five mortality in Sudan.

DISCUSSION

In this study variables namely Place of delivery, Adolescent marriage, Tetanus Toxoid vaccination during pregnancy, Antenatal care services, and Type of birth attendant are significantly affect the survival of under-five children. The result of this study shows that delivery in a health facility has a negative association with under-five mortality. A study in low and middle-income countries revealed that delivery at health facility has a statistically significant effect on neonatal mortality, it has resulted in a 29% decrease in the risk of neonatal mortality (Tura *et al.,* 2013).Another study, in rural Tanzania, concluded that mothers who gave birth outside a health facility had a 1.85 times higher risk of experiencing neonatal mortality compared to mothers who delivered a health facility (Ajaari *et al.,* 2012). Babies born to mothers protected against neonatal tetanus are less likely to die before reaching the age of five. In Bangladesh, the number of newborns dying of neonatal tetanus each year decreased from about 40 per 1,000 live births in 1986 to about 3 per 1,000 live births in 2001, as a result of the intensive immunization programs that raised the proportion of women who were vaccinated against tetanus from 4 Percent to 90 percent over the same period (UNICEF, 2004). The findings of this study also revealed that there is negative relationship between having assistance at delivery by a skilled attendant and under-five mortality. Amouzou *et al.,* (2017) found that, after the first day of life, newborns delivered by a skilled attendant at birth were 16% less likely to die within 2–27 days compared to those who were not, in sub–Saharan African countries.

Table 1. Regression of cause variables on the Outcome variable (U5MR), Northern Sudan, 2014

Model		1	2	3	4	5	6	7
constant		148.62 (1.91) [0.105]	142.99 (2.06) [0.079]	149.41 (2.428) [0.041]	162.48 (2.945) [0.016]	174.09 (3.268) [0.008]	156.79 (3.186) [0.009]	154.56 (3.180) [0.008]
Estimated Coefficients of:	P_d	-1.424 (-0.88) [0.415]	-1.420 (-0.94) [0.380]	-1.102 (-1.20) [0.265]	-0.938 (-1.11) [0.295]	-1.371 (-1.98) [0.076]	-1.762 (-3.30) [0.007]	-1.755 (-3.32) [0.006]
	A_m	-7.813 (-1.92) [0.415]	-7.923 (-2.11) [0.073]	-7.387 (-2.44) [0.040]	-6.962 (-2.46) [0.036]	-5.463 (-2.39) [0.038]	-5.432 (-2.40) [0.035]	-5.292 (-2.37) [0.036]
	T_t	-1.907 (-1.26) [0.255]	-2.136 (-1.87) [0.104]	-2.072 (-1.97) [0.085]	-1.801 (-1.98) [0.079]	-1.246 (-1.85) [0.094]	-1.435 (-2.26) [0.045]	-1.558 (-2.55) [0.026]
	A_c	2.688 (1.81) [0.120]	2.832 (2.210) [0.063]	2.699 (2.420) [0.042]	2.356 (2.58) [0.030]	2.377 (2.63) [0.025]	2.587 (2.99) [0.012]	2.580 (3.01) [0.011]
	B_a	-0.589 (-0.71) [0.507]	-0.719 (-1.16) [0.283]	-0.792 (-1.50) [0.172]	-0.674 (-1.44) [0.185]	-0.859 (-2.04) [0.068]	-0.999 (-2.58) [0.026]	-1.036 (-2.72) [0.019]
	I_w	-0.185 (-0.63) [0.255]	-0.183 (-0.67) [0.525]	-0.146 (-0.65) [0.533]	-0.145 (-0.67) [0.517]	-0.208 (-1.03) [0.328]	-0.169 (-0.86) [0.407]	
	M_e	-0.609 (-0.66) [0.535]	-0.476 (-0.67) [0.527]	-0.459 (-0.69) [0.513]	-0.594 (-0.98) [0.352]	-0.535 (-0.90) [0.391]		
	M_a	1.855 (0.82) [0.444]	1.989 (0.971) [0.364]	1.813 (0.991) [0.351]	1.577 (0.92) [0.383]			
	R_s	0.255 (0.36) [0.728]	0.346 (0.613) [0.559]	0.279 (0.583) [0.576]				
	I_s	0.340 (0.34) [0.747]	0.235 (0.28) [0.791]					
	I_t	-0.141 (-0.26) [0.805]						
R^2		0.807	0.804	0.802	0.794	0.775	0.757	0.740
Adjusted R^2		0.452	0.525	0.580	0.611	0.617	0.624	0.632
F		2.274	2.879	3.607	4.333	4.910	5.697	6.833
Significant level		0.162	0.087	0.042	0.021	0.012	0.006	0.003

Source: Own calculations based on Data from MICS tabulations (2014), Dependent variable (*U5MR*).

A skilled attendant at birth protects neonatal deaths in Latin America and the Caribbean also (Singh *et al.,* 2014). The results of this study indicate that vaccinating women against tetanus toxoid during pregnancy will reduce infant and child deaths. According to Rahman *et al.,* (1982), in rural Bangladesh, neonatal mortality rates was reduced from 78.3/1000 to 42.8/1000 for infants whose mothers had received 2 tetanus injections during pregnancy compared to infants whose mothers did not receive tetanus immunization. Singh *et al.,* (2012) found that 16% of the neonatal deaths in rural northern India can be attributed to lack of at least two doses of tetanus toxoid vaccination during pregnancy. With regard to early marriage, the results of a study done by Guilbert (2013) in Senegal showed that it increases the mother's risk of child death by 6.7% and the number of children who die to mother by 0.15. This is contrary to our findings of negative relation between women having married or entered a marital union before their 15th birthday and under-five mortality. Perhaps this is due to the Sudanese culture related to marriage, as most families in rural Sudan prepares the girl from an early age to carry out family burden, or it is due to the small number of underage girls who were included in the study. Although Studies examining the effectiveness of prenatal care on maternal and newborn health outcomes provided mixed results, we did not find the interpretation to our finding that shows positive relation of pregnant women having antenatal care services by skilled provider and under-five mortality.

Conclusion and recommendations

The study aims to identify the most important factors affecting under-five mortality rate using the linear regression method and suggesting some recommendations that can reduce under-five mortality. The study based on data collected by the Government of Sudan in collaboration with the United Nations Children's Fund (UNICEF) in 2014 as part of the MICS program. The results indicate that only five of the eleven variables used in the analysis showed a significant effect in under-five mortality rate (U5MR), namely; Place of delivery (Pd), Adolescent marriage (Am), Tetanus Toxoid vaccination during pregnancy (Tt), Antenatal care services (Ac), and Type of birth attendant (Ba). As (Am) and (Ac) have unexpected signs, we conclude that having delivery in a health facility and giving assistance at delivery can avoid delivery risks and therefore reduces infant deaths, and protection against neonatal tetanus also reduces the risk of neonatal tetanus and therefore reduces infant and child mortality. In this regard, it is very important to note that the provision of health care centers, skilled health providers in all areas, providing tetanus vaccines for all needy people and raising awareness of riskiness of home delivery, childbearing without skilled provider assistance as well as awareness of the dangers of disregarding children vaccination against vaccine-preventable childhood diseases, especially tetanus will improve the health of the

mothers and children which in turn reduce under–five mortality rate in Sudan.

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